PATENT ABSTRACTS OF JAPAN

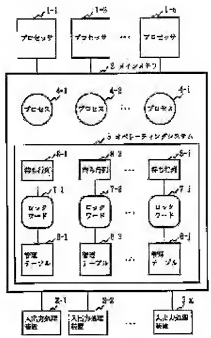
(11)Publication number : **2001-084235**
(43)Date of publication of application : **30.03.2001**

(51)Int.Cl. **G06F 15/177**
G06F 12/00

(21)Application number : **11-256766** (71)Applicant : **NEC CORP**
(22)Date of filing : **10.09.1999** (72)Inventor : **TANABE JUN**

(54) EXCLUSIVE CONTROL METHOD USING LOCK PARTICLE SIZE SATISTICAL INFORMATION AND COMPUTER-READABLE RECORDING MEDIUM WITH PROGRAM RECORDED THEREIN

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce overhead time due to memory bank contention and a wasteful switch processing and to improve the performance of the multiplex processor computer system of a common memory system by dynamically changing the lock waiting system through the use of lock particle size satistical information.
SOLUTION: When it is decided that a resource Rj cannot be locked, an operating system 5 executes a lock waiting system deciding processing and decides a lock waiting system. Flag information contained in the system call of a process 4-1 is referred to, and it is checked as to whether the other processing to be executed which does not use the resource Rj exists. When the processing exists, a lock-waiting system is set to be a try lock system. When the processing does not exist, the lock-waiting system is decided to be a spin system or a sleep system on the basis of lock particle size statistical information of the resource Rj, which is stored in a management table 6-j, corresponding to the resource Rj stored in the management table 6-j corresponding to the resource Rj.



size statistical information calculation processing of S13 from lock particle size statistical information Pn-1 of the resource R to last time, and the lock particle size Tn newly computed this time.

[0038]Pn = function F1 (Pn-1, Tn) -- (1)

[0039]Here to the lock particle size statistical information P. Total of the square of total of the minimum of a tmin= lock particle size, the maximum of a tmax= lock particle size, and t= lock particle size, the number of times of tc= lock, and a t2= lock particle size, the average value of a tav= lock particle size, the variance of a tbu= lock particle size, and other information are included. That is, it is P= (tmin, tmax, t, tc, t2, tav, tbu, in addition to this).

[0040]If the process N+1 tends to lock the resource R when the process N locks the resource R, in the lock decision processing of Step S1 of drawing 2, it will be judged with a lock being impossible, and waiting method decision processing for a lock of Step S3 will be performed. In the waiting method decision processing for a lock of this step S3, as it is shown in a following formula (2) from flag information flag and the lock particle size statistical information Pn which show whether there is any processing which should be performed to others, or there is nothing, waiting method Mnfor lock+1 is determined.

[0041]Mn+1 = function F2 (Pn, flag) -- (2)

[0042]When the waiting method for a lock is determined as a spin system, as it is shown in a following formula (3) from the lock particle size statistical information Pn, spin waiting time Wn+1 is determined.

[0043]Wn+1 = function F3 (Pn) -- (3)

[0044]

[Effect of the Invention]As explained above, since this invention changes the waiting method for a lock dynamically using lock particle size statistical information, it can decrease memory bank competition and the overhead time by useless switch processing etc. As a result, the performance of the multiprocessor computer system of a shared memory method can be raised.

[0045]Since he is trying for this invention to determine spin waiting time using lock particle size statistical information when the waiting method for a lock is determined as a spin system, it can decrease the overhead time by memory bank competition further.

[Translation done.]

updated. In [the average value of the number of times of a lock and a lock particle size, a variance, the maximum, the minimum, etc. are contained in lock particle size statistical information, and] Step 13, The number of times of a lock is carried out +1, or the average value of a lock particle size, a variance, the maximum, the minimum, etc. are updated based on this lock particle size computed at Step S12, and the lock particle size statistical information registered into management table 6-j.

[0028]. And in the Wake rise processing of Step S14, are making lock waiting of the resource Rj the last. When the identifier is registered with reference to queuing 8-j into which the identifier of the process which is sleeping is registered, for example, the identifier registered into the head is taken out, and the process of the identifier is caused. That is, a process is made into a ready state and it is made the candidate for quota of CPU time.

[0029]Next, in Step S1 of drawing 2, the operation at the time of judging with the ability of the resource Rj in which the lock request was carried out by the process 4-1 not to be locked is explained.

[0030]In Step S1, when it judges with the ability of the resource Rj not to be locked, the operating system 5 performs waiting method decision processing for a lock of Step S3, and determines the waiting method for a lock.

[0031]In the waiting method decision processing for a lock of this step S3, the waiting method for a lock is determined as follows, for example.

[0032]First, it is investigated whether with reference to the flag information included in the system call which the process 4-1 published, there is any processing which the resource Rj is not used for the process 4-1, and also should be performed. And when there is processing which should be performed to others, let the waiting method for a lock be a try lock method. On the other hand, when there is no processing which should be performed to others, based on the lock particle size statistical information of the resource Rj stored in management table 6-j corresponding to resource Rj, it determines whether to make the waiting method for a lock into a spin system, or adopt a sleep method. For example, when long, when the average value of a lock particle size is shorter than the time which sleep processing takes, a spin system defines a sleep method, it is defined, when equal, while is beforehand defined of a spin system and the sleep methods, and it is considered as a method. When the waiting method for a lock is determined as a spin system, spin waiting time is determined based on the lock particle size statistical information of the resource Rj registered into management table 6-j. For example, let the average value or the minimum of a lock particle size be a waiting interval for spin.

[0033]When making the waiting method for a lock into a spin system at Step S3 is determined, the operating system 5 performs waiting processing for spin of step S4. In the waiting processing for spin of step S4, if waiting and spin waiting time pass that the spin waiting time determined at Step S3 passes, lock decision processing of Step S1 will be performed again.

[0034]When making the waiting method for a lock into a sleep method at Step S3 is determined, waiting processing for sleep of Step S5 is performed. In the waiting processing for sleep of this step S5, the process 4-1 of lock request origin is made to sleep, and the processor 1-1 to which the process 4-1 was assigned is opened. That is, the processor 1-1 to which it was assigned is opened by making the process 4-1 into wait status. The identifier of the process 4-1 is registered into queuing 8-j corresponding to the resource Rj in which the process 4-1 carried out the lock request in Step S3.

[0035]When making the waiting method for a lock into a try lock method at Step S3 is determined, try lock processing of Step S6 is performed. In try lock processing of this step S6, lock failure is notified to the process 4-1 of lock request origin. The process 4-1 which received this notice performs other processings which do not use the resource Rj.

[0036]Drawing 4 is a figure for explaining processing of lock particle size statistical information calculation processing (Step S13) of drawing 3, and the waiting method decision processing for a lock of drawing 2 (Step S3) in detail.

[0037]In [if the process N unlocks the resource R (not shown)] lock particle size calculation processing of Step S12, The lock particle size Tn is computed and the new lock particle size statistical information Pn is computed with a following formula (1) in the following lock particle

invention, When a spin system is determined as a lock method, in order to make spin waiting time to optimal thing, when a waiting method for a lock is determined as a spin system, said lock waiting time is determined based on lock particle size statistical information of said resource.
[0015]
[Embodiment of the Invention]Next, an embodiment of the invention is described in detail with reference to drawings.
[0016]Drawing 1 is the example of composition of the multiprocessor computer system of the shared memory method with which the exclusive control method using the lock particle size statistical information of this invention is applied a shown block diagram, and Two or more processors (computer) 1-1 - 1-n, It comprises the main memory 2 shared by each processor 1-1 - 1-n, and two or more sets of the input/output processors 3-1 - and 3-m.
[0017]On the main memory 2, the process 4-1 of becoming a unit of processing - 4-i, and the operating system 5 exist. the resource (a memory resource and I/O resources) with which the operating system 5 serves as an exclusion unit -- each time -- the lockword 7-1 for every resource - 7-j and the queuing 8-1 - 8-j which are managed by the management table 6-1 - 6-j and the management table 6-1 - 6-j are included.
[0018]Drawing 2 and drawing 3 are the flow charts showing the example of processing of the operating system 5, and explain operation of this example with reference to each figure below.
[0019]In the process 4-1 which is operating on the now 1-1, for example, a processor, when exclusive access to the resource Rj (not shown) managed by management table 6-j is needed, the process 4-1 publishes the system call which requires the lock of the resource Rj. The flag information which shows whether this system call has the processing which the resource Rj is not used and also should be performed in the process 4-1 is included.
[0020]If the above-mentioned system call is published, the operating system 5 will perform processing shown in the flow chart of drawing 2 on which processor (for example, processor 1-n). That is, the operating system 5 is read by processor 1-n, is controlling operation of processor 1-n, and makes the processing shown in the flow chart of drawing 2 perform.
[0021]First, in the lock decision processing of Step S1, the operating system 5 executes a test-and-set command. refers to lockword 7-j to the resource Rj, and it writes the value which shows that it is a locked position in lockword 7-j. (and when it is shown that the value of lockword 7-j at the time of reference is an unlock condition (i.e., when the resource Rj can be locked), and when). When lock processing of Step S2 is performed and it is shown that the value of lockword 7-j at the time of reference is a locked position (i.e., when the resource Rj cannot lock), waiting method decision processing for a lock of Step S3 is performed.
[0022]In the now S1, for example, a step, when it judges with a lock being possible, In lock processing of Step S2, the operating system 5 notifies a lock success to the process 4-1 of lock request origin, and also acquires current time, and writes it in management table 6-j corresponding to resource Rj by making it into lock start time.
[0023]The process 4-1 of lock request origin will start the processing which uses the resource Rj monopolistically, if a lock success is notified.
[0024]Then, if the process 4-1 publishes the system call which requires unlocking of the resource Rj, the operating system 5 will perform processing shown in the flow chart of drawing 3 on which processor (for example, processor 1-n). That is, the operating system 5 is read by processor 1-n, is controlling operation of processor 1-n, and makes the processing shown in the flow chart of drawing 3 perform.
[0025]First, in unlocking processing of Step S11, the operating system 5 writes the value which shows an unlock condition in lockword 7-j corresponding to the resource Rj by which the unlocking demand was carried out.
[0026]Subsequently, in lock particle size calculation processing of Step S12, the time (lock particle size) when the resource Rj was locked is computed by asking for the difference of the lock start time and current time which are stored in management table 6-j corresponding to resource Rj.
[0027]Then, in lock particle size statistical information calculation processing of Step S13, the lock particle size statistical information about the resource Rj stored in management table 6-j is

that it should mind in order not to drop the performance of a computer system frequently more than needed to a lockword, and there is. That is, since the degradation by memory bank competition will be caused if it accesses frequently more than needed to a lockword, such a thing must avoid. Therefore, the most efficient solution when the waiting for a lock occurs is a method for which it waits fixed time depending on the way of waiting depending on which the process which has taken the lock is the timing which unlocked the resource, and can acquire a lock timely. It is thought that it specifically depends for this waiting time on timing with the access pattern to that resource, i.e., a lock, and unlocking and the time (lock particle size) locked when saying further.

[0008]When a lock particle size is small enough, the spin system of (1) is suitable. By the case where a lock particle size is larger enough than the time (namely, switch processing time) which sleep processing takes, when there is no processing which should moreover be performed to others, the sleep method of (2) is suitable. On the contrary, when there is processing which should be performed to others, it will be said that the try lock method of (3) is suitable. That is, when a lock particle size is small enough, CPU time is consumed vainly, but since the time is very slight, the spin system of (1) which has easy control, and little load is suitable. When a lock particle size is larger enough than switch processing time, control becomes complicated, but since CPU time can be used effectively, the sleep method of (2) is suitable.

[0009]However, a lock particle size does not necessarily become a fixed value for every lock, and is dynamically changed according to the employment situation of a system. For this reason, in the conventional exclusive control method as which the waiting method for a lock is determined fixed for the whole computer system or every resource, processing of the optimal waiting method for a lock according to a lock particle size is not performed, but, as a result, there is a problem that the performance of a computer system may be reduced. For example, when the lock particle size of the resource with which processing by a spin system is assigned fixed becomes large in connection with system management, access to a lockword will be performed frequently more than needed, and will cause the degradation by memory bank competition. It will become impossible to use CPU time effectively, when the lock particle size of the resource with which processing by a sleep method is assigned fixed becomes smaller than switch processing time in connection with system management for example, only by control becoming complicated as compared with a spin system.

[0010]Then, the purpose of this invention is to change the waiting method for a lock dynamically using the statistical information of a lock particle size, and is in raising the performance of the whole system by decreasing memory bank competition and the overhead time by useless switch processing etc.

[0011]Although the art of changing the size of an exclusion unit is indicated to JP,4-297949,A based on statistical information, such as generating frequency of competition, based on the statistical information of a lock particle size, the waiting method for a lock is not changed dynamically.

[0012]

[Means for Solving the Problem]An exclusive control method using lock particle size statistical information of this invention, In a multiprocessor computer system of a shared memory method with which two or more processors share main memory in order to attain the above-mentioned purpose, Whenever a resource shared by said two or more processors is locked, compute a lock particle size, and. When lock particle size statistical information of said resource is updated based on a computed this lock particle size and lock waiting to said resource occurs, a waiting method for a lock is determined based on lock particle size statistical information of said resource.

[0013]To a lock method which average value of a lock particle size is included in lock particle size statistical information, and is determined as it here based on lock particle size statistical information, for example. For example, a sleep method which makes spin system [which tries a lock to a resource again after spin waiting time progress], or lock request origin sleep is contained.

[0014]An exclusive control method using lock particle size statistical information of this

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the exclusive control method using the lock particle size statistical information which can reduce the degradation of the computer system by the overhead time of exclusive control especially about the exclusive control method in the multiprocessor computer system of a shared memory method.
[0002]
[Description of the Prior Art]In the multiprocessor computer system of the shared memory method with which two or more processors share main memory, In order to guarantee use with a successive (exclusive) resource (lump of a series of processings to the resources in which reference is performed and a process makes a change etc., and its resources) by a process (procedure) generally, The test-and-set command which performs the reference to a field and setting out on the memory in which the lockword was stored with 1 machine clock is used. Although a lockword is generally placed on main memory in many cases, it may be placed not on main memory but on the memory of specification (exclusive use) depending on a computer system.
[0003]The conventional general exclusive control method using a test-and-set command was as follows. For example, when a certain process Pa requires exclusive use of a certain resource Ra, an operating system with a test-and-set command. With reference to the lockword corresponding to resource Ra, it investigates whether resource Ra is a locked position, and the lockword corresponding to resource Ra is changed into the value which shows a locked position.
[0004]And when it is shown that a lockword is not a locked position, a lock success is notified to process Pa and exclusive use of resource Ra is permitted. On the other hand, when it is shown that a lockword is a locked position, an operating system performs processing (processing at the time of waiting generating for a lock) performed when a resource is not able to be locked. To the method (waiting method for a lock) of the processing performed at the time of waiting generating for a lock. (1) The spin system for which it continues waiting while carrying out spin until a lock is acquirable, (2) Since there is processing which the sleep method and (3) resource Ra which make process Pa sleep and open a processor (CPU) for other processes are not used since there is no processing which should be performed to others, and also should be performed, The lock to resource Ra is given up and there are a try lock method etc. to which other processings which do not use resource Ra for process Pa are made to perform.
[0005]In the conventional exclusive control method, the waiting method for a lock is defined fixed for the whole computer system or every resource, and an operating system processes the waiting method for a lock defined fixed.
[0006]
[Problem(s) to be Solved by the Invention]Generally, although the simplest spin system is adopted in the multiprocessor computer system of a shared memory method in many cases, it is dependent on the character of the resource used as the exclusion object which method should be adopted intrinsically.
[0007]Here, when the waiting for a lock occurs, I hear that it is made not to access the point

which recorded a program for making processing which determines a waiting method for a lock based on lock particle size statistical information of said resource perform and in which machinery reading is possible.

[Translation done.]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]Whenever a resource shared by said two or more processors is locked in a multiprocessor computer system of a shared memory method with which two or more processors share main memory, compute a lock particle size, and. An exclusive control method using lock particle size statistical information characterized by determining a waiting method for a lock based on lock particle size statistical information of said resource when lock particle size statistical information of said resource is updated based on a computed this lock particle size and lock waiting to said resource occurs.
[Claim 2]An exclusive control method which used lock particle size statistical information, wherein said lock particle size statistical information includes average value of a lock particle size in an exclusive control method using the lock particle size statistical information according to claim 1.
[Claim 3]In an exclusive control method using the lock particle size statistical information according to claim 1, a waiting method for a lock determined based on said lock particle size statistical information, An exclusive control method which used lock particle size statistical information being a sleep method which makes spin system [which tries a lock to said resource again], or lock request origin sleep after spin waiting time progress.
[Claim 4]An exclusive control method which used lock particle size statistical information determining said spin waiting time based on lock particle size statistical information of said resource in an exclusive control method using the lock particle size statistical information according to claim 3 when a waiting method for a lock was determined as a spin system.
[Claim 5]Whenever a resource shared by said two or more processors is locked in a multiprocessor computer system of a shared memory method with which two or more processors share main memory, compute a lock particle size, and. When lock particle size statistical information of said resource is updated based on a computed this lock particle size and lock waiting to said resource occurs, A waiting method for a lock is determined based on lock particle size statistical information of said resource, and information which shows whether lock request origin can perform processing which does not use said resource, An exclusive control method using lock particle size statistical information determining said spin waiting time based on lock particle size statistical information of said resource when a determined this waiting method for a lock is a waiting method for a lock which tries a lock to said resource again after spin waiting time progress.
[Claim 6]In an exclusive control method using the lock particle size statistical information according to claim 5, a waiting method for a lock determined based on said lock particle size statistical information, An exclusive control method using lock particle size statistical information being a try lock method which makes other processings perform to spin system [which tries a lock to said resource again after spin waiting time progress], sleep method [which makes lock request origin sleep], or demand origin.
[Claim 7]Whenever a resource is locked by computer, compute a lock particle size, and. When processing which updates lock particle size statistical information of said resource based on a computed this lock particle size, and lock waiting to said resource occur, A recording medium